Acute Hemoptysis and Bronchoscopic Follow-up After Cryoablation of the Pulmonary Veins

Basler, Lisa ; Berlier, Charlotte ; Straub, Gilles ; Steffel, Jan ; Franzen, Daniel

DOI: https://doi.org/10.1097/lbr.0000000000000585

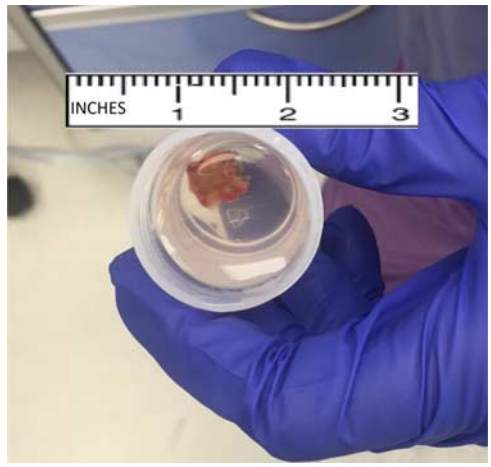

FIGURE 4. Foreign body after extraction submerged in formalin.

followed by the proliferation of fibroblasts and vascular endothelial cells at the injured site, leading to the formation of granulation tissue.[5] The presence of chronic inflammation, granulation tissue, and deformation of the bronchial tree as well as atrophic, hyperplastic, and dystrophic changes in the ciliated epithelia promotes epithelization of the FB and impairs bronchial patency.

Our patient presented with pulmonary infection associated with bronchial obstruction. The infection was refractory to traditional treatment due to an endobronchial obstruction. Upper airway extraction was not possible, as the patient had a continued need for mechanical ventilation, and there was a risk of injuring the vocal cords and other upper airway structures. The factors that influenced the use of flexible bronchoscope over rigid bronchoscope were the center's expertise, smaller size and better navigational properties. Flexible bronchoscope permitted the examination of the lower airways with less risk of trauma. An accessory extraction pathway in the form of a tracheostomy was utilized to remove the FB, avoiding further damage. This case illustrates a pathogenic chronic endobronchial FB, its dissection, and a complex extraction procedure which included a tracheal opening for removal. After a detailed review of the available literature (Cochrane, EBSCOhost, and PubMed), most of the previous publications involved pediatric patients and acute aspiration of FBs. Debeljak et al[6] published 62 cases of bronchoscopic removal of FBs in adults in a period of 24 years, only one was associated with tracheostomy and was not simultaneously performed. The successful outcome and complete resolution of the patient's illness was largely due to a careful and coordinated approach between clinical services.

Lee Gonzalez, MD
Adriana Candelario, MD
Yomayra Otero, MD
Luna Torres-Luna, MD
Onix Cantres, MD
William Rodriguez-Cintron, MD
Veterans Affairs Caribbean Healthcare System, San Juan, PR

REFERENCES

1. Eren Ş, Balci A, Dikici B, et al. Foreign body aspiration in children: experience of 1160 cases. *Ann Trop Paediatr*. 2003;23:31–37.
2. Chen C, Lai C, Tsai T, et al. Foreign body aspiration into the lower airway in Chinese adults. *Chest*. 1997;112:129–133.
3. Karakoç F, Karadağ B, Akbenlioğlu C, et al. Foreign body aspiration: what is the outcome? *Pediatr Pulm*. 2002;34:30–36.
4. Kalil A, Metersky M, Klompas M, et al. Management of adults with hospital-acquired and ventilator-associated pneumonia: 2016 Clinical Practice Guidelines by the Infectious Diseases Society of America and the American Thoracic Society. *Clin Infect Dis*. 2016;63:5.
5. Anderson JM. Biological responses to materials. *Ann Rev Mater Res*. 2001;31:81–110.
6. Debeljak A, Sŏrli J, Mušič E, et al. Bronchoscopic removal of foreign bodies in adults: experience with 62 patients from 1974-1998. *Eur Respir J*. 1999;14:792.

Acute Hemoptysis and Bronchoscopic Follow-up After Cryoablation of the Pulmonary Veins

To the Editor:

Cryoablation of the pulmonary veins has become a favorable treatment option for symptomatic atrial fibrillation refractory to conservative treatment with antiarrhythmic drugs.[1] Although it is generally considered a safe procedure, necrotic lesions of anatomically adjacent structures (eg, esophagus, phrenic nerve, vagal nerve, bronchi, and lungs) have

L.B. and C.B. contributed equally.

Disclosure: J.S. has received consultant and/or speaker fees from Amgen, Astra-Zeneca, Atricure, Bayer, Biosense Webster, Biotronik, Boehringer-Ingelheim, Boston Scientific, Bristol-Myers Squibb, Daiichi Sankyo, Medtronic, Merck/MSD, Novartis, Pfizer, Sanofi-Aventis, Abbott, and Zoll. He reports ownership of CorXL. J.S. has received grant support through his institution from Bayer Healthcare, Biosense Webster, Biotronik, Boston Scientific, Daiichi Sankyo, Medtronic, and St. Jude Medical/Abbott. The remaining authors declare that there is no conflict of interest or other disclosures.

DOI: 10.1097/LBR.0000000000000585

been reported, including a few cases of hemoptysis.[2–5] To the best of our knowledge, we here present the first report on serial bronchoscopic follow-up of a cryoablation-induced lesion to the left main bronchus with successive healing of the lesion under conservative treatment.

CASE REPORT

A 44-year-old female patient presented with increasing dyspnea and minor hemoptysis for 4 days. Three days before the onset of her symptoms, she underwent cryoablation of the pulmonary veins due to symptomatic paroxysmal atrial fibrillation resistant to antiarrhythmic drugs. Each pulmonary vein had been ablated for 240 ms with minimal temperatures of −47 to −49°C (Artic Front ablation balloon 28 mm; Medtronic) under anticoagulation therapy with heparin (2 intravenous single shots of 5000 and 4000 Units, respectively). The immediate postinterventional course was uneventful without any clinically apparent bleeding complications. To prevent scar tissue–induced thromboembolism in the left atrium therapeutic oral anticoagulation with rivaroxaban was introduced per standard protocol.[6]

By the time of presentation at our emergency room, the patient was hemodynamically stable with normal oxygen saturation on ambient air. All laboratory values (blood count, creatinine, urea, and C-reactive protein) were within normal range. The initial computed tomographic scan with angiography excluded any severe active arterial bleeding and showed only discrete ground glass opacity in the area of the right inferior pulmonary vein. Transthoracic echocardiography revealed no structural abnormalities with normal left and right heart function. We admitted the patient to our ward, administered 500 mg tranexamic acid orally, and stopped oral anticoagulation with rivaroxaban. A flexible video bronchoscopy revealed a necrotic lesion of ~0.5×1 cm in the distal left main bronchus, adjacent to the left superior pulmonary vein (LSPV) (Fig. 1). Using endobronchial ultrasound, we identified the LSPV lying underneath the necrotic lesion; the distance to the bronchial wall was 3.3 mm. We administered an antitussive medication with codein and dextromethorphan as well as antibiotic therapy with amoxicillin/clavulanate to prevent a rupture of the necrotic lesion into the left atrium with fatal consequences. To prevent the formation of thrombotic material in the left atrium after the cryoablation, unfractionned heparin in low therapeutical doses (targeted antifactor X activity of 0.3 to 0.4 IU/mL) was started.

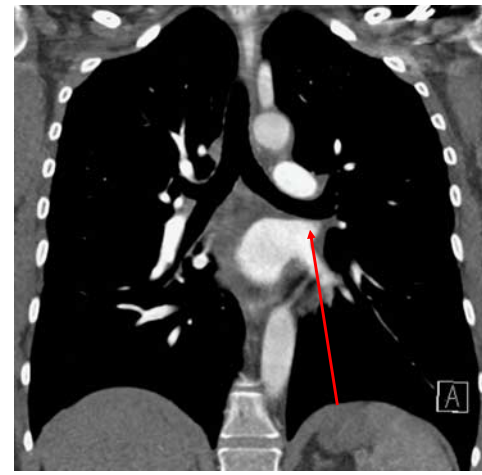

FIGURE 1. Computed tomographic thorax angiography, demonstrating the anatomic correlation of the distal left main bronchus and the left superior pulmonary vein (arrow).

The patient remained under observation on our regular ward and we performed a bronchoscopic follow-up at day 4, which revealed a stable situation of the necrotic lesion without signs of active bleeding or progression of the necrotic area. She was discharged after 7 days, and the anticoagulation was changed to dabigatran because of the availability of a rapid reversibility using the specific antidote (Idarucizumab). We performed serial bronchoscopic follow-up examinations at days 12, 22, 28, 2 months, and 3 months (Fig. 2). The necrotic area initially showed a demarcation of the boarders, and thereafter a gradual shrinking, finally resulting in the formation of scar tissue. At 2 months, fibrinous material attached to the healing ulcer was observed during a clinical diagnosed viral infection of the upper respiratory tract. The viral and microbiological endotracheal sampling returned negative. At 3 months the ulcer was completely healed. The patient stayed asymptomatic. The oral anticoagulation was later changed to Edoxaban due to a presumed adverse drug reaction to dabigatran (dizziness and headache), which resolved afterwards.

DISCUSSION

There are a few cases of hemoptysis after cryoablation of the pulmonary veins reported in the literature. In 2 reports, bronchoscopy showed similar lesions in the left main bronchus close to the left upper pulmonary vein.[4] We can explain this similar localization because of the anatomic proximity of the LSPV and the left main bronchus (Fig. 1). In a single center retrospective analysis, Kumar et al[3] reported 6 of 283 patients (2.1%) with minor hemoptysis, appearing at day 0 to day 5 and resolving spontaneously with or without discontinuation of

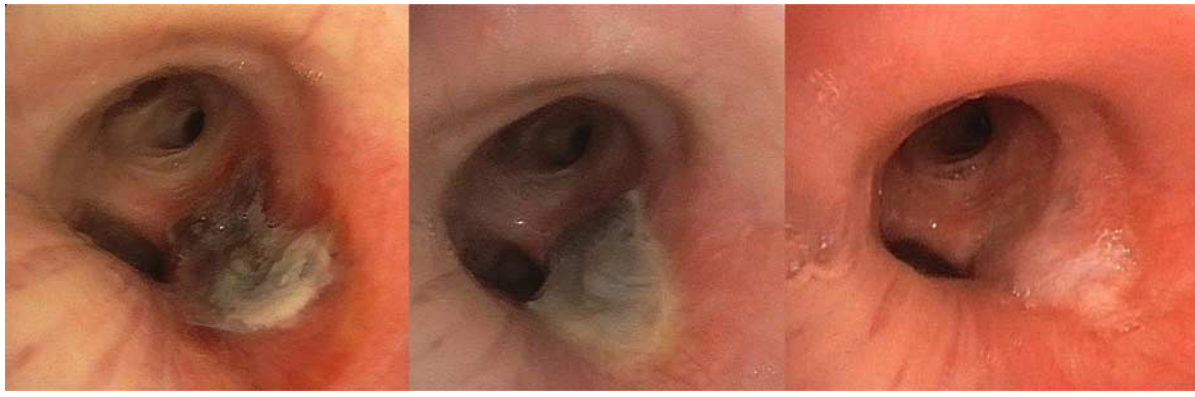

FIGURE 2. Bronchoscopic follow-up at day 1, day 28, and after 3 months.

anticoagulation; only 2 patients had visible lesions in the bronchoscopy. Furthermore, there are 2 reports of massive hemoptysis after cryoablation, one requiring immediate surgical intervention because of an atriobronchial fistula with fatal outcome.[7] The second case, a bleeding ulcer, required massive blood transfusion and reversal of the anticoagulation.[8]

The pathophysiological mechanism of the ulcer formation is considered to be a thermal injury of the bronchial walls during the cryoablation. Verma et al[9] performed live bronchoscopy during a cryoablation in 10 patients and visualized ice formation in 59% of the freezes only in the left main bronchus during cryoablation in the left upper pulmonary vein; in contrast, in the right bronchus no ice formation was observed during cryoablation of the right upper pulmonary vein. The minimal temperature achieved, the duration of cryoablation and a deeper positioning of the balloon in the pulmonary vein have been reported as risk factors for bronchial necrosis.[3] In our case, the minimal temperature (−47 to −49°C) was within the targeted range. An alternative cause of hemoptysis after cryoablation is the development of a pulmonary vein stenosis, causing lung circulatory stagnation and pulmonary infiltrates causing diffuse parenchymatous bleeding[5] or leading to pulmonary artery dysfunction with hypertrophy of the bronchial arteries (occurring a few months after the cryoablation[10]).

In our case, we provide the first serial endoscopic follow-up documentation of a bronchial necrosis, guided by the 3 phases of scar tissue formation (inflammation, proliferation, and remodeling) with a special interest for the proliferative phase where the risk of rupture is the highest. Over 3 months we were able to demonstrate a spontaneous healing of the necrotic area with conservative therapy.

CONCLUSIONS

Localized bronchial necrosis causing hemoptysis is a rare event after cryoablation of the pulmonary veins for treatment of atrial fibrillation. As fatal outcomes have been published due to venobronchial fistulas as well as rupture, patients as well as health care providers need to be sensitized to this complication, which needs to be investigated with immediate chest computed tomographic scan and bronchoscopy. Temporary discontinuation or reduction of the anticoagulation therapy should be considered. We recommend follow-up bronchoscopies to document the healing of the necrotic area and to anticipate emerging complications, such as secondary superinfections of the lesion.

Lisa Basler, MD*
Charlotte Berlier, MD*
Gilles Straub, MD*
Jan Steffel, MD†
Daniel Franzen, MD*
Departments of *Pneumology
†Cardiology, University Hospital Zurich
Zurich, Switzerland

REFERENCES

1. Klein G, Oswald H, Gardiwal A, et al. Efficacy of pulmonary vein isolation by cryoballoon ablation in patients with paroxysmal atrial fibrillation. *Heart Rhythm*. 2008;5:802–806.
2. Su W, Kowal R, Kowalski M, et al. Best practice guide for cryobaloon ablation in atrial fibrillation: the compilation experience of more than 3000 procedures. *Heart Rhythm*. 2015;12:1658–1666.
3. Kumar N, Timmermans C, Das M, et al. Hemoptysis after cryoablation for atrial fibrillation: truth or just a myth? *Chest*. 2014;146:e173–e175.
4. van Opstal JM, Timmermans C, Blaauw Y, et al. Bronchial erosion and hemoptysis after pulmonary vein isolation by cryoballoon ablation. *Heart Rhythm*. 2011;8:1459.
5. Martí-Almor J, Jaureguí-Abularach ME, Benito B, et al. Pulmonary hemorrhage after cryoballoon ablation for pulmonary vein isolation in the treatment of atrial fibrillation. *Chest*. 2014;145:156–157.

6. Steffel J, Verhamme P, Potpara TS, et al. EHJ 2018, EHRA practical guide on the use of NOACS. *Eur Heart J*. 2018;39:1322.
7. Rahul ND. Atriobronchial fistula formation as a devastating complication of left atrial catheter sablation for atrial fibrillation, Abstract AB-29-1. *Heart Rhythm*. 2006;3:S59.
8. Jayaschandran V, Mertens AN, Patel VK, et al. Life-threatening massive hemoptysis after cryoablation for atrial fibrillation. *J Bronchol Interv Pulmonol*. 2018;25:67–69.
9. Verma N, Gillespie CT, Argento AC, et al. Bronchial effects of cryoballoon ablation for atrial fibrillation. *Heart Rhythm*. 2017;14:12–16.
10. Watanabe K, Nitta J, Sato A, et al. Hemoptysis after five months of cryoballoon ablation: What is the relationship? *Heart Rhythm Case Rep*. 2017;3:357–359.

Delayed Presentation of Cholethorax Following Hepatic Microwave Ablation and Resection in a Patient With Metastatic Rectal Cancer

To the Editor:

We report a case of a 41-year-old man who developed a delayed, recurrent bilious pleural effusion (cholethorax) following open hepatectomy and cholecystectomy.

CASE REPORT

A 41-year-old man presented to the emergency department with right-sided back pain. A computed tomography (CT) scan of the abdomen was unremarkable. He was discharged home; however, returned a few days later with intractable back pain and dyspnea with diminished breath sounds over the right lung field. A chest CT with intravenous (IV) contrast showed a new right-sided pleural effusion. He was admitted and a bedside thoracentesis showed dark green fluid. Five-hundred seventy milliliters of fluid was removed and analysis determined it to be an exudate (pleural fluid showed: lactate dehydrogenase was 2214 U/L, total protein 3.2 g/dL, glucose 114 mg/dL, white blood cell count 18060 with 97% neutrophils) with negative cultures. Bilirubin was not sent. His chest pain improved and he was discharged home with outpatient oncology follow-up to await cytology results, which later returned negative. He developed dyspnea and received an outpatient thoracentesis 3 weeks later with 1200 mL of yellow fluid removed. His dyspnea again improved. Pleural studies were similar to initial findings and cytology was negative. Lacking a unifying diagnosis, he was referred to interventional pulmonary (IP) for evaluation.

In IP clinic, he appeared healthy, and complained of dyspnea on exertion. His medical history was significant for rectal cancer metastatic to the liver that was diagnosed 20 months prior. He had received neoadjuvant chemotherapy with leucovorin, fluorouracil, and oxaliplatin (FOLFOX) followed by concurrent chemoradiation with capecitabine. Six months after initiating chemotherapy, he achieved partial response in primary and metastatic lesions, and underwent abdominoperineal resection with end descending colostomy and 4 separate liver wedge resections followed by ultrasound-guided microwave ablation of remaining lesions. This was followed by adjuvant chemotherapy with FOLFOX to complete 8 cycles; however, he had recurrence in the liver (Fig. 1) and was started on treatment with leucovorin, fluorouracil, and irinotecan (FOLFIRI) along with bevacizumab. Nine months after the initial surgery, he underwent right hepatectomy, segmental liver resection, and cholecystectomy. A 10.3×6.8×12.1 cm simple fluid collection was noted on imaging following this procedure. This fluid collection was again noted on presentation to the emergency department. It was stable in size and attributed to postoperative seroma.

Given this history, the suspicion for cholethorax or malignant effusion was high and repeat thoracentesis with positron emission tomography-computed tomography was recommended. A total of 2000 mL was extracted with guidance of pleural manometry (Fig. 2). The pleural elastance was 5 cm H_2O/L, consistent with free-flowing fluid. The total bilirubin content of the fluid was 3.4 mg/dL (serum bilirubin 0.5 mg/dL), which was consistent with a cholethorax. positron emission tomography-computed tomography did not show fluorodeoxyglucose avidity in the parietal pleura. Given the elevated bilirubin, an magnetic resonance imaging (MRI) of the abdomen with IV gadoxetate disodium (Eovist) was performed which showed a 4.0×7.4 cm fluid collection between the resection margin and the right hemidiaphragm with rapid accumulation of Eovist, consistent with biloma. Eovist is a hepatobiliary specific agent that is taken up by organic anion transporter proteins on hepatocytes (same transporter protein for bilirubin) and undergoes ~50% excretion through the biliary route, providing delayed hepatic and biliary tree imaging.[1] The MRI also showed potential extravasation into the pleural space (Fig. 3).

After consultation with interventional gastroenterology and radiology, a percutaneous drainage catheter (Argon Skater Medical, Frisco, TX) was placed into the biloma. An endoscopic retrograde cholangiopancreatography with cholangiogram was performed and showed a bile leak from the right posterior intrahepatic duct. A 10 Fr×9 cm Sof-Flex plastic stent (Cook Medical, Bloomington, IN) was placed in the common bile duct. Concurrently, a 14 Fr chest tube (Teleflex Medical, Research Triangle Park, NC) was inserted to remove the rest of the right-sided pleural effusion (~2200 mL) and immediately removed after ultrasound confirmation of complete fluid evacuation. The effusion was negative for malignancy. Following this procedure, the biloma drain output and color improved, along with his pulmonary symptoms. A few weeks later, he presented with fever and chills

Disclosure: There is no conflict of interest or other disclosures.
DOI: 10.1097/LBR.0000000000000586